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BEARING ASSEMBLY WITH CARBONATE RESISTANT ANTI-SEIZING PROPERTIES

STATEMENT OF GOVERNMENT INTEREST

[0001] The invention described herein was made in the performance of official duties by one or more employees of the Department of the Navy, and the invention herein may be manufactured, practiced, used, and/or licensed by or for the government of the United States of America without the payment of any royalties thereon or therefor.

CROSS REFERENCE TO OTHER PATENT APPLICATIONS

[0002] None.

BACKGROUND OF THE INVENTION

(1) Field of Invention

[0003] The present invention generally relates to bearings, and more particularly to bearings with metallic components which are immersed in seawater when in use.

(2) Description of the Prior Art

[0004] The prior art is represented by a shaft with a bearing surface and a rotor (or slider) incorporating a conventional bearing (See **FIGS. 1** and **2**). There is a problem with prior art bearings when the bearing assembly is required to function after being immersed in seawater for an extended period. When immersed, carbonates form in a comparatively narrow void space between the bearing and the shaft. These carbonates can build to the point in which the void space is filled such that the bearing seizes up.

[0005] In order to prevent a bearing assembly from corroding in seawater, housing and shafts may be made with more corrosion resistant metal alloys. The more corrosion resistant that a metal alloy is, the less "active" that the metal is (See Galvanic Series Table). Less active metal alloys are more "noble" than more active metals. Often these corrosion resistant components are made from a nickel alloy.

[0006] When these more noble metals are mechanically connected to more active metallic components in the Galvanic Series Table (such as steel and zinc) and immersed in an electrolyte (seawater); a galvanic (electric) circuit may set up. This kind of reaction frequently occurs in oceangoing ships, submarines, oil drilling platforms, etc. The nobler component may become the cathode and the more active component may become the anode.

[0007] When conditions in the electrolyte are favorable (i.e., a comparatively stagnant rate of electrolyte exchange inside the bearing); the electrolytic process may cause hydroxide to form at the cathode. An explanation is found in "Corrosion Basics, An Introduction" by Pierre R. Roberge. From page 130: "The cathodic reaction, hydrogen ion and/or oxygen reduction (hydroxide) causes the environment immediately adjacent to the cathodes to become alkaline; therefore, ions such as calcium, zinc or magnesium may be precipitated as oxides to form a protective layer on the metal."

[0008] Many natural waters are self-inhibiting to corrosion due to the deposition of a scale on metals by precipitation for naturally occurring ions. From page 131: "The most widely used cathodic precipitation-type … are the carbonates of calcium and magnesium because they occur in natural waters … At the correct pH, the deposit will be fairly hard and smooth and similar to an eggshell." The pH adjustment necessary for carbonate deposition to occur is brought about by the cathodic reaction mentioned above. It is this eggshell-like deposit which, once it has built up to fill the entire void space in the bearing, may cause the bearing to seize up.

[0009] In the prior art, there is an electrical pathway (brought about by mechanical connections such as bolting or welding) between the underwater structure (anode) and the bearing surface of a metallic shaft (cathode). The larger the exposed surface area of the anode (underwater structure); the greater the electrical potential that is created between the structure and the bearing surface of the shaft (cathode). The presence of sacrificial anodes on the structure increases the magnitude of the electrical potential. The more corrosion resistant that the metallic bearing surface (cathode)is; the greater the magnitude of the electrical potential. The farther apart on the Galvanic Series Table that the underwater structure material and the metallic shaft surface material are; the greater the magnitude of the electrical potential. The larger the electrical potential between the anode (underwater structure) and the cathode, (metallic shaft surface); the greater the problem of carbonate deposition.

[0010] Build-up of carbonate deposits can cause failure of a bearing in underwater or on-ship handling mechanisms. Current solutions such as greasing a marine bearing shaft may inhibit carbonate deposits, but may not reduce the deposits as much as desired. Furthermore, the introduction of grease into the immediate vicinity of the shaft may be undesirable in certain situations where friction is an important aspect of the overall mechanism (such as underwater cable handling or capstan mechanisms).

[0011] As such, there is a need for a bearing assembly which inhibits galvanic reactions from forming in the bearing space between a shaft and a rotor or between a shaft and a slider.

SUMMARY OF THE INVENTION

[0012] In one aspect of the invention, a carbonate resistant anti-seizing shaft and bearing assembly may include a metallic load-carrying shaft, an electrically non-conductive sleeve which fits over the shaft, and a metallic surrogate shaft surface that fits over the non-conductive sleeve. According to exemplary embodiments of the present invention, this surrogate shaft surface is electrically isolated from the rest of the underwater structure. A rotor assembly may be rotatable around the surrogate shaft surface. The remainder of the bearing assembly is unchanged from the prior art - including a bearing made from a suitable material.

[0013] In another aspect of the invention, a carbonate resistant anti-seizing shaft and bearing assembly may include a metallic load-carrying shaft, an electrically non-conductive sleeve which fits over the shaft, and a metallic surrogate shaft surface which fits over the non-conductive sleeve, as above.

The surrogate shaft surface is electrically isolated from the rest of the underwater structure. In this aspect, a slider assembly is movable with a linear motion along the shaft of the surrogate shaft surface – the motion as determined by the length of the surrogate shaft surface. The remainder of the bearing assembly is unchanged from the prior art.

[0014] These and other features, aspects and advantages of the present invention will become better understood with reference to the following drawings, description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] **FIG. 1** is a top view of a prior art bearing assembly;

[0016] **FIG. 2** is a cross section view of the bearing assembly of **FIG. 1**.

[0017] **FIG. 3** is a top view of a bearing assembly exemplifying the present invention; and

[0018] **FIG. 4** is a cross sectional view of the bearing assembly of **FIG. 3**.

DETAILED DESCRIPTION OF THE INVENTION

[0019] The following detailed description is of the best currently contemplated modes of carrying out the invention. The description is not to be taken in a limiting sense, but is made merely for the purpose of illustrating the general principles of the invention, since the scope of the invention is best defined by the appended claims.

[0020] The present disclosure relates generally to a bearing modified for extended life when the bearing and some or all of the surrounding structure is immersed in seawater.

[0021] The present invention, more specifically, relates to electrically isolating a shaft bearing surface from forming a galvanic reaction between a mechanically-connected underwater structure (with seawater as an electrolyte). The galvanic reaction can cause degradation of the bearing due to a buildup of carbonate deposits.

[0022] For example, an exemplary embodiment may include an electrically-isolated surrogate shaft surface disposed between the load-carrying shaft and a surrounding rotor or slider. This arrangement prevents carbonate deposits from forming on a bearing surface when the bearing assembly is immersed in seawater.

[0023] What is common to the apparent aspects of this invention is that the electrical path between the underwater structure and the metallic bearing surface of the shaft is interrupted. The closer that this interruption is to the shaft bearing surface and the smaller the surface area of all metal that is electrically connected to the bearing surface and exposed to seawater, the greater is the reduction of carbonate deposition on the bearing surface.

[0024] Referring to **FIG. 3** and **FIG. 4**; a bearing assembly **100** includes a load-carrying shaft **110** as a primary bearing assembly component in an underwater cable handling mechanism or an underwater capstan mechanism. The bearing assembly **100** includes an electrically non-conductive sleeve **112** which fits over the shaft **110**, and a corrosion resistant metallic surrogate shaft **114** with an outer surface **116**, which fits over the sleeve.

[0025] The outer surface **116** may serve as a surrogate shaft surface in place of the shaft **110**. This surrogate shaft surface **116** is electrically isolated from the rest of the underwater structure. A bearing **118** may be disposed between the surrogate shaft surface **116** and a rotor or slider **120**. As a rotating element, the rotor **120** assembled with the bearing **118** may be attached coaxially and may rotate in regard to the load-carrying shaft **110**, sleeve **112**, and surrogate shaft **114**. In another embodiment, assembly of the rotor **120** and bearing **118** may be stationary, and the load-carrying shaft **110**, sleeve **112**, and surrogate shaft **114** may rotate.

[0026] Optionally, as a sliding element, the slider **120** assembled with the bearing **118** may be attached coaxially to the load-carrying shaft **110**, sleeve **112**, and surrogate shaft **114**, and may slide with a linear movement - as limited by the length of the surrogate shaft surface **116**. Dimensions are not shown for the bearing assembly **100** because the assembly may be sized to suit operational needs.

[0027] In another embodiment, the slider **120** and bearing **118** may be stationary, and the load-carrying shaft **110**, sleeve **112**, and surrogate shaft **114** may slide with a linear motion.

[0028] The shaft **110** may be part of, or electrically connected to, a larger structure such as a seawater filled tank, or underwater on the hull of a ship or on the support of an oil rig. Due to strength requirements, the shaft **110** may be made of a metallic material such as steel, stainless steel, cast iron, bronze, a nickel or nickel copper alloy, or other metal. These materials are conductive and as such would benefit by aspects of this invention. The rotor or slider **120** may be made of any of the same materials as the shaft **110**, but may have lower strength requirements, enabling other, non-metallic and/or electrically non-conductive materials to be considered, such as plastic, ceramic, or rubber. The rotor or slider **120** and the bearing **118** may be disposed in a manner surrounding at least a portion of the load-carrying shaft **110**, sleeve **112**, and surrogate shaft **114** in a location where the components are immersed in saltwater or other electrolyte mediums in the ambient environment.

[0029] Exemplary embodiments of the present invention may electrically isolate the load-carrying shaft **110** (which is mechanically / electrically connected to underwater structure) from the surrogate shaft surface **116**; thereby, preventing seawater from promoting a galvanic reaction between the surrogate shaft **114** (made of corrosion resistant "noble" metal) and the rest of the underwater structure (made of more "active" metal).

[0030] The foregoing description of the preferred embodiments of the invention has been presented for purposes of illustration and description only. It is not intended to be exhaustive nor to limit the invention to the precise form disclosed; and obviously many modifications and variations are possible in light of the above teaching.

[0031] It should be understood, that the foregoing relates to preferred embodiments of the invention and that modifications may be made without departing from the spirit and scope of the invention as set forth in the following claims.

BEARING ASSEMBLY WITH CARBONATE RESISTANT ANTI-SEIZING PROPERTIES

ABSTRACT OF THE DISCLOSURE

A bearing assembly including a load-carrying shaft, an electrically non-conductive sleeve fitted over the shaft, and a surrogate shaft surface made from a corrosion resistant metal surrounding the non-conductive sleeve. The bearing assembly electrically isolates the load-carrying shaft from an underwater structure. This isolation prevents carbonates from building up in the void space between the metallic surrogate shaft surface and a bearing. A rotor or slider subassembly may be included in the bearing assembly. A bearing may be affixed as part of the rotor or slider assembly located between the slider and the surrogate shaft surface.

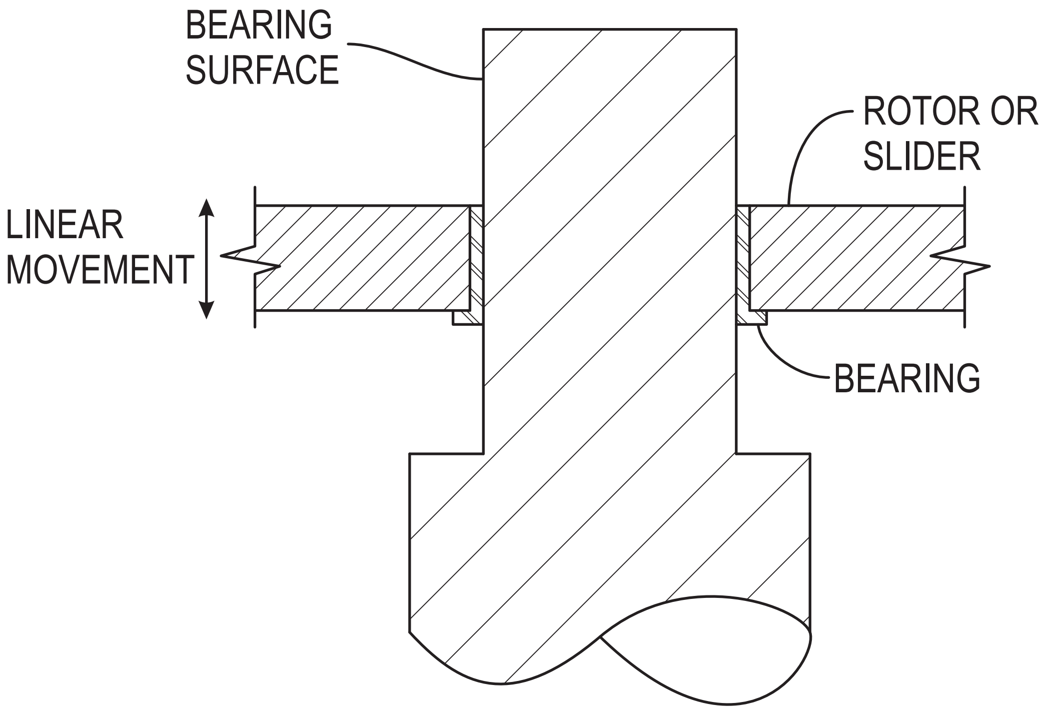

FIG. 1
(PRIOR ART)

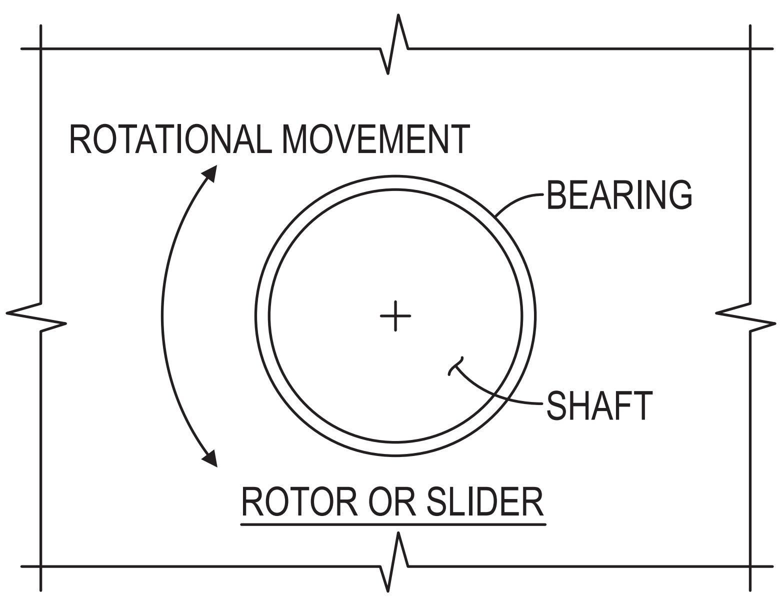

FIG. 2
(PRIOR ART)

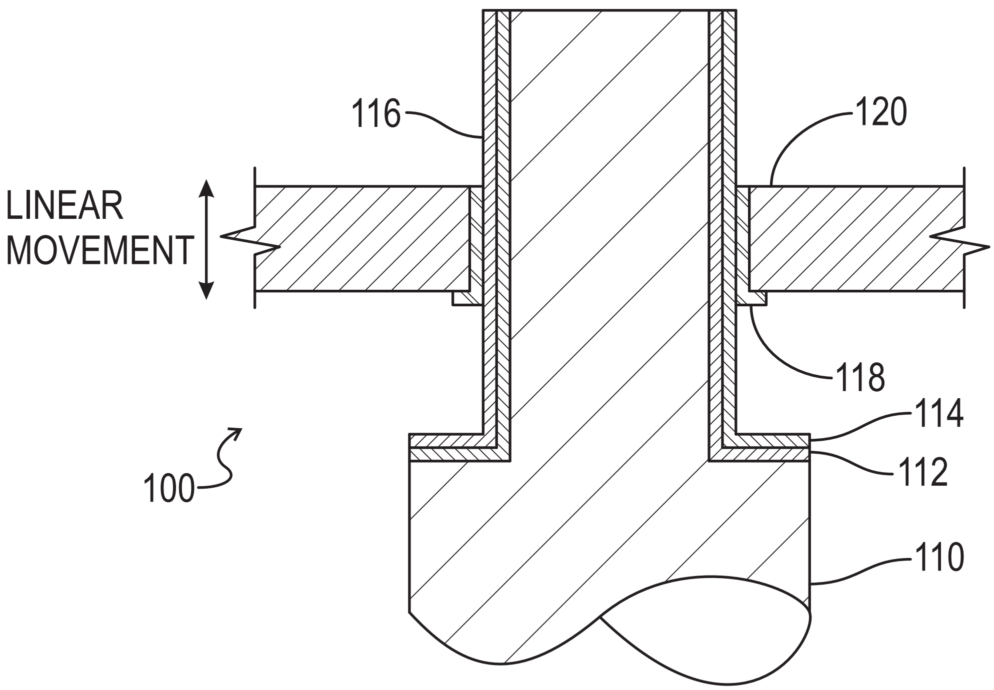
116
120
LINEAR
MOVEMENT
118
114
100
112
110

FIG. 3

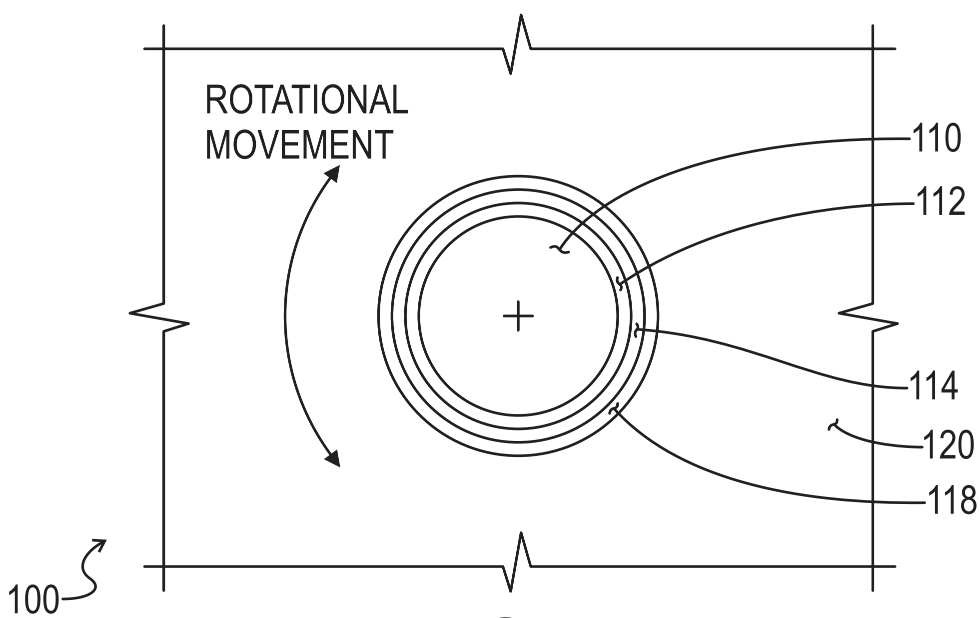
ROTATIONAL
MOVEMENT
110
112
114
120
118
100

FIG. 4